

CLASS 103. PUMPS,
Rotary,

Cent.

Brit. 1324
of 1863

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A.D.1863. MAY 26. N^o 1324.
HENRY'S PROVISIONAL SPECIFICATION.

Henry's Pump AP

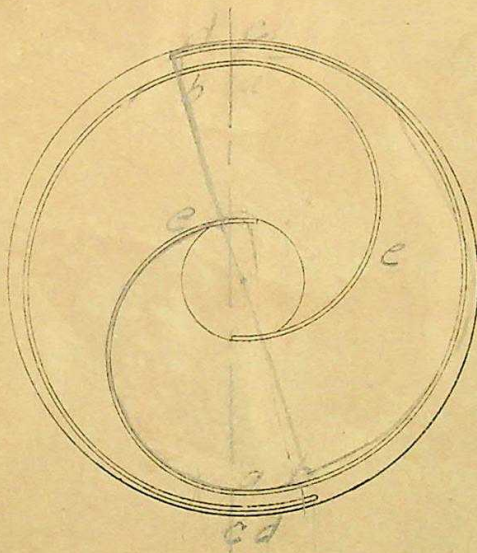
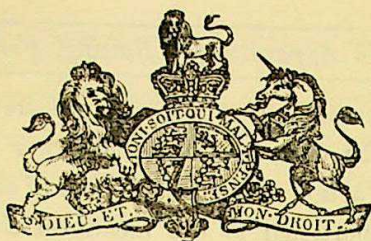


Fig 7

The drawing left with Provisional Specification is not colored.

Draw

LONDON: Printed by GEORGE EDWARD EYRE and WILLIAM SPOTTISWOODE,
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A.D. 1863, 26th MAY. N° 1324.

1 sh. drawing.

Centrifugal Pumps, &c.

LETTERS PATENT to Michael Henry, of 84, Fleet Street, in the City of London, Patent Agent, for the Invention of "IMPROVEMENTS IN APPARATUS FOR RAISING, FORCING, AND MOVING FLUIDS." — A communication from abroad by Louis Coignard, of 33, Boulevard Saint Martin, Paris, France.

Sealed the 25th September 1863, and dated the 26th May 1863.

PROVISIONAL SPECIFICATION left by the said Michael Henry at the Office of the Commissioners of Patents, with his Petition, on the 26th May 1863.

I, MICHAEL HENRY, of 84, Fleet Street, in the City of London, Patent Agent, do hereby declare the nature of the said Invention for "IMPROVEMENTS IN APPARATUS FOR RAISING, FORCING, AND MOVING FLUIDS," communicated to me from abroad by Louis Coignard, of 33, Boulevard Saint Martin, Paris, France, to be as follows:—

This Invention relates to centrifugal pumps and aquamotors, that is 10 machines in which a wheel, drum, vessel, or revolving apparatus, herein-after, to avoid repetition, called "drum or wheel," rotates in a fixed casing, fluid being drawn up into such drum or wheel, and after travelling through it being expelled by centrifugal force.

The Invention is based on the following law of mechanics:—"That forces 15 are to each other as the velocities they communicate to the same moving body in the same interval of time," and on the following deduction, "that when

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fluid travels through a centrifugal wheel or drum, from an inlet at the centre or axis, to an outlet at the circumference, the power required to impart and maintain the centrifugal action of a given volume of such fluid, to be delivered in a given time, is proportional to the mean velocity with which the fluid travels through such wheel or drum," whence it follows that the velocity of 5 centrifugal travel is a factor of the resistance to be overcome, and this factor can be regulated or controlled at pleasure, because the velocity may be retarded in various ways, one way being to enclose the drum or wheel in a casing or close receiver, having outlets, whereof the sectional area has such a ratio to the sectional area of the channels through the wheel or drum that the 10 velocity of the fluid's motion to the circumference may be retarded as required; the outlets from the wheel or drum should be comparatively very small, and of much less sectional area than the mean sectional area of the channels through the wheel or drum. For these purposes apparatus is so arranged and combined that fluid, (1), shall travel slowly through the drum or wheel; 15 (2), shall, when at the periphery, exert equal pressure in all directions on the sides of the outlets through which it escapes, or tends to escape; (3), shall be prevented from returning from the wheel or drum into the suction passages or inlets; and, (4), shall acquire its rotary motion with little disturbance. The drum or wheel is also prevented from wasting power on the surrounding 20 body of fluid. The drum or wheel should have a casing fitting close round it, and it may be cylindrical, conical, or of other form, but the form recommended is spherical or ellipsoidal.

The following arrangement is preferred for carrying the Invention into effect:—A spherical or ellipsoidal drum, wheel, or vessel revolves on a vertical 25 axis within a fixed casing, which fits close round it, but without friction between the fixed and moveable surfaces. The fluid enters the drum or wheel at the poles or ends, through which the axis passes, and escapes through a narrow annular, circular, or circumferential slot formed in its periphery; the plane of this slot is at right angles to the axis of rotation; this slot leads into 30 a corresponding slot in the casing, whence the fluid issues into a close receiver or annular pipes. The annular slots are packed or fitted with leather or other flexible lips, bands, washers, or rings. The outlets may, however, be at some other part of the circumference; they may be formed by an arrangement of spiral or excentric curved vanes, as shewn in the Drawing. Spiral deflecting 35 guide plates are fitted in the suction ways, to communicate to the fluid the direction of the vane's motion. The boss of the drum or wheel may be extended into the suction pipes, and one or more of the vanes may be prolonged and carried spirally round the axis, or the ends of the drum may be

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packed with washers, each washer having four (or more or less) oblong or oval slots, whereof each is respectively cut in a transverse direction to the corresponding slot of the washer next over it. Pins are passed through these slots, and the washers are controlled by springs. The vanes may be of such
5 form that the commencement of their convex surfaces shall be tangential to the circumference of the boss, and the end of their concave surface to that of the wheel or drum.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed
by the said Michael Henry in the Great Seal Patent Office on the
10 26th November 1863.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, MICHAEL HENRY, of 84, Fleet Street, in the City of London, Patent Agent, send greeting.

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters
15 Patent, bearing date the Twenty-sixth day of May, in the year of our Lord One thousand eight hundred and sixty-three, in the twenty-sixth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said Michael Henry, Her special licence that I, the said Michael Henry, my executors, administrators, and assigns, or such others as I, the
20 said Michael Henry, my executors, administrators, and assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "**IMPROVEMENTS IN**
25 **APPARATUS FOR RAISING, FORCING, AND MOVING FLUIDS**," communicated to me from abroad by Louis Coignard, of 33, Boulevard Saint Martin, Paris, France, upon the condition (amongst others) that I, the said Michael Henry, my executors or administrators, by an instrument in writing under my, or their, or one of their hands and seals, should particularly describe and ascertain the
30 nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

NOW KNOW YE, that I, the said Michael Henry, do hereby declare the
35 nature of the said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement

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thereof as communicated to me, reference being had to the accompanying Drawings, and to the letters and figures marked thereon, that is to say :—

This Invention relates to centrifugal pumps and aquamotors, that is to say, to machines in which a wheel, drum, vessel, or apparatus rotating in a fixed casing is employed, and in which centrifugal action is exerted on fluid which is drawn up into it, travels through it, and is expelled from it. I herein-after call the rotating vessel or apparatus the “wheel or drum,” whatever be its form or configuration, and I call the passages in which the fluid travels through it the “fluid channels.”

The present Invention principally relates to improvements on certain aqua- 10
motors and pumps for which I obtained a Patent dated Sixth February, One thousand eight hundred and sixty-two, and numbered 316, and which, as well as the present Invention, is based on the following law of mechanics :—That motive forces are to each other as the velocities they communicate to the same moveable body in the same interval of time; and the improvements chiefly 15
consist in applying this principle by arranging and combining apparatus in such manner that water shall be caused to move very slowly through the wheel or drum from the axis (at which it is admitted) to the periphery (from which it is discharged), whatever its volume and velocity. For this purpose the delivery outlet or outlets through which the fluid is discharged from the wheel or drum 20
are formed of very small sectional area in proportion to the capacity of the wheel or drum, or, in other words, their sectional area is formed much smaller than the mean sectional area of the fluid channels. An improved aquamotor or pump is constructed according to this Invention by causing a wheel or drum to revolve within a fixed casing, which fits closely round it but without actual 25
contact. The fluid enters the drum or wheel at the ends, and escapes through a narrow annular or circumferential slot formed in its periphery, and leading through a corresponding slot in the casing into annular pipes or other receiver. The form of wheel or drum recommended in most cases is spherical or ellipsoidal (a figure generated by the revolution of an ellipsis round its minor axis), 30
but it may be conical or of other external form.

An apparatus constructed according to this Invention is represented in the accompanying Drawings.

Figures 1, 2, and 3 shew a horizontal pump, and Figures 4, 5, and 6, a vertical pump. Figure 1 is a longitudinal section on the line *f, f*, of 35
Figure 2, Figure 2 is a plan, and Figure 3 side view; Figure 4, vertical section on line *g, g*, of Figure 5, Figure 5 is a plan, Figure 6 side view.

A is the wheel or drum, consisting of a vessel (here shown as spherical), mounted on an axis H, and revolving in a fixed spherical casing B, which fits

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closely round the drum but does not come into frictional contact therewith. Fluid channels are formed in the drum by means of vanes, which are fitted to a boss on the axis H and lead to the periphery of the drum. G¹¹ is a suction pipe, which divides into branch pipes G, G¹, which enter the drum A through 5 openings formed in the ends or poles of the casing and drum. D, D, is a narrow slot or opening formed in the drum A, and extending round it; this opening leads into an opening of corresponding shape formed opposite it in the casing B (see view on enlarged scale, Figure 9); these openings (which are in a plane at right angles to the axis H) communicate with a close receiver E, 10 which extends round the casing B, and may be of any desirable form, but it is preferably a circular tube or torus. This receiver E communicates with pipes F. The water is drawn into the drum through the pipe G¹¹, G, G¹, and after passing through the fluid channels formed by the vanes is discharged through the slot D, D, into the receiver E, and thence through the pipes F to 15 any desired point. The sectional area of the slot D is regulated according to the capacity of the drum; for example, in a drum A, of 12 inches diameter, with a lift of 60 feet, the opening D may be $\frac{3}{8}$ inch deep. I is the general framework. When the drum is cylindrical or of other form than spherical, the outlet is formed on similar principles, and either in the circumference, as 20 in Figures 1 and 4, or elsewhere at the end of the fluid channels. For high velocities and large quantities of water an ellipsoidal drum is preferred. When the apparatus is to form a suction pump and discharge into the open air, or when it is to form a force pump and discharge into an air vessel, a drum of the form of a truncated cone or of straight or curved radiating pipes 25 is preferred, the water being ejected from the receiver in the ordinary manner by pressure of air through pipes having their ends submerged in the water at the bottom of the air vessel; and in these pumps a tight joint may be obtained at the junction of the suction pipe by fitting a packing, Figures 10 and 11, and herein-after described, in a box or socket T, formed at the end of the suction 30 pipe, into which extends the end of the axis H, which is made hollow, so that the water is drawn in through it, and it has a stay across it carrying a pivot which turns in a step in the suction pipe. Pumps so arranged I call hydro-pneumatic.

A reduced area of outlet may be obtained as in Figure 7 (section), in 35 which *a*, *b*, *d*, *c*, are the mouths of the fluid channels formed by portions of vanes *a*, *b*, and *c*, *d*, whereof the portions *a*, *b*, are evolvents of a very small circumference, and *c*, *d*, are arcs; these portions, *a*, *b*, *c*, *d*, are at the ends of the larger or main portions, *a*, *e*, *e*, of the vanes, which take a wider curve, and are evolvents of a larger circle, or they may be merely arcs of a circle or

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sections of a spiral. A spherical or ellipsoidal form of drum is preferred for lift and force pumps, in which the drum revolves in water, as these forms can be turned true, so that the drum and casing may fit each other closely, which is important.

In the pumps constructed according to this Invention all parts of the drum's delivery outlet are equidistant from the axis, in order that the water may exert equal and uniform pressure thereon, for which purpose also it is brought to the delivery outlet faster than it can be discharged therefrom, the outlet being of such small area as compared with the area of the drum. The water discharged is prevented from returning along the sides of the casing to the suction pipe by the casing, which fits closely round the drum, or by using packing; and to prevent power being wasted on the surrounding water the drum works closely in its casing, and just sufficient passage is left for the water to reach the receiver E. The water may be caused to acquire a rotary motion without disturbance by using vanes of the form shewn in Figure 8, and by admitting the water at the axis; for this reason, and also to obtain a reduced area of inlet, the suction pipe is divided into branches. To reduce the shock of the vanes against the water when admitted into the drum the vanes are recessed, as shown at *c*, *c*¹, Figures 1 and 4, and a small recess *a*² is also formed in the vanes near the opening D, to keep the passage through that opening clear. The water, or each particle thereof, pursues a spiral path as it travels through the drum, owing to the two motions communicated to it, namely, its rotary and its centrifugal motion, wherefore a spiral vane may be used, its spiral curving in a direction opposite to that of the drum's rotation, or making a complete revolution from the boss to the periphery, or the arc form of vane, Figure 8, may be adopted, the convex surface of the vane starting tangential to the boss, as at *a*, and its concave surface terminating at *b*, tangential to the slot or delivery opening D. The form of vanes, however, does not materially affect the work of the machine, as the water travels slowly between them. Any number of vanes may be used in spherical and elliptical drums; two are sufficient for a spherical drum of six inches diameter. Although the drum works so closely in its casing that the water cannot carry extraneous bodies between them nor return to the suction pipe, yet as additional precaution the edges of the inlet and outlet may be fitted with leather or other flexible rings, flanges, or lips *x*, Figure 9, which I call flexible fittings or packing, and which when forced back by the water close the space between the casing and drum, or a metallic packing, herein-after described, may be used. The pumps are worked by a steam engine or other motor through a pulley J on an axis K, whence motion is transmitted by spur

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gear L, as in Figures 1, 2, and 3, or bevel gear L, as in Figures 4, 5, and 6, to an axis M, carrying a pulley N, which drives a pulley O on the axis H. The peculiarity of this gearing consists in the use of a wood or cast-iron pulley P between and in contact with the pulleys N and O, which
5 prevents the axes M and H from being dragged together when the strap is tightened, and connects and strengthens the gearing, and assists in transmitting motion. Q is the axis of the pulley P. The axis H may be steadied by guides g, g^1 , one of which g^1 forms a step for it in Figure 4; i, k , Figure 4, is a threaded rod set by a nut for adjusting the axis H; it passes through a
10 gland j , and its end k bears against a steel ball on which the axis turns. R is an improved metallic packing, shewn in section, Figs. 1, 4, 10, which may be fitted in the suction pipe where the axis H enters; it consists of metal rings or washers R (four generally suffice), ground true, and drilled through to fit round the shaft H. In each ring are four oblong or oval
15 slot holes equidistant from each other and from the centre; their longer sides are straight and parallel. The four slots of each ring are cut in the same or parallel directions; against each ring a steel or brass spring w presses, one to each ring, so as to push it in the direction m, m^1 , of the slot's length, that is, towards the axis H, so that each ring fits close round half thereof, and when
20 the rings are arranged one over the other (round the axis), so that the slots of each lie transverse or obliquely to those of the ring next over it, as at m, m^1 , Fig. 11, a sufficiently tight packing will be obtained. T, Figures 10 and 11, is a stuffing box in which the rings R are fitted, and to the bottom of which are secured four pins or studs t , which pass through the slots, and about fit them
25 breadthwise, so as to prevent the rings R from turning with the axis H; and S is a gland screwed down on the rings so as to keep them in place, both pins and gland allowing them their necessary play in the longitudinal direction of their slots. Figure 11 is a plan of the box T, shewing one ring with its pins t and the respective positions of the four springs w . When the axis is horizontal
30 its bearings may be so arranged that it may be adjusted in the drum without removing the latter from its casing. For this purpose a bearing U, Figures 1, 12, 13, is used, formed of three conical pieces held together by a wedge o , with two parallel and one bevelled side, and sliding in a groove or mortice in the box T^1 . The axis may thus be adjusted by adjusting the conical pieces in their
35 grooves in the box T^1 by nuts and screws working between lugs in each such piece. This bearing may be applied when the axis is vertical, and it is then fitted in the gland S instead of in a box T^1 , and the end of the axis opposite the pulley O may have a shoulder cast on it, and be adjusted by a pointed guide, such end and arrangements being enclosed in a stanch cover formed

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of a cylinder V bolted to a bell-shaped piece X, so that either V or X may be removed separately, the piece V being bolted to the box T¹, and containing a nut to work the set screw of the axis.

To prime the pump, water is injected at the top Y or by the force pipe; if air be expelled through Y, and is kept in the pump by a foot valve at the lower part of the suction pipe to prevent it from stopping work in case of air being drawn into the suction pipe a reservoir W, Figure 6, supplied with water by the force pipe Z, may be used, its lower part holding sufficient water for priming; this may be effected in various ways, as, for example, if the pump be vertical by a pipe p, Figures 4 and 6, leading from the reservoir to the top Y. Where this pipe p enters the reservoir W is a drop valve q, jointed at its upper end so as to close by its own weight; and r, shown in dotted lines, Figure 5, is a pipe which leads from the reservoir W to a part s at or below its level in the force pipe, whereby if the pump cease work its rotation is stopped or retarded till water passes from W into the drum through the pipe r, and expels the air, which will pass into the pipe p, lift the valve q, and escape through the reservoir W; or for a horizontal pump, its rotation need not be stopped, as the pipe p may be connected with the suction pipe at any point Y¹, Figure 2, so that if the pump cease work for want of water, the valve would open and supply it.

Figure 14 shows another (but self-acting) arrangement for this object, in which a valve seat a is fixed in a cylinder b, attached to the suction pipe i at c; d is the valve capable of working up and down, and guided by a rod f, having a cylinder or piston e at its lower end, which works in a cylinder g, having at top a channel or opening leading outside the valve box through a passage g¹; the piston e only extends to just below the channel g, so that it opens it when the valve is depressed; the pipe g¹ is connected with the basin W by a pipe h, hence if air be drawn up through the suction pipe, the valve d would drop on its seat, and the piston e would open the channel g, and admit water from the reservoir W through the pipe g¹ into the suction pipe, whence it would rise to the drum, and expel the air until the pump tends to discharge more water than the pipe g¹ supplies, when the atmospheric pressure would raise the valve d and stem f, and cause its piston e to close the channel g, and shut off the flow of water from W to the suction pipe i.

I have described two arrangements for obtaining a comparatively small outlet, namely, by a narrow circumferential slot, as in Figures 1 and 4, and by approaching vanes, as in Figure 7; but I do not restrict myself to these two arrangements, as others might be used (without departing from my Invention) for carrying into effect this object or method, which con-

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stitutes an essential feature of construction according to these improvements, namely, forming the drum or wheel with a delivery outlet or outlets, whereof the sectional area is very small comparatively to the capacity of the drum or wheel, and therefore much smaller than the mean sectional area of the fluid
5 channels leading to such outlet or outlets.

Having now described the nature of the said Invention, and in what manner the same may be performed, I declare that I claim,—

First, the improved aquamotor or pump, in which a wheel, drum, or apparatus rotates in a closely fitting casing, and is arranged with vanes and with
10 comparatively small delivery opening or openings, substantially as described.

Second, the improved hydro-pneumatic pump herein-before described, in respect of the arrangement and combination of parts of which the same consists.

Third, the general arrangement and combination of apparatus herein-before described.

15 Fourth, the improved spiral or evolvent vanes formed with recesses, as herein-before described.

Fifth, the application and arrangement of flexible fittings and metallic packing, as herein-before described.

In witness whereof, I, the said Michael Henry, have hereunto set my
20 hand and seal, this Twenty-fifth day of November, One thousand eight hundred and sixty-three.

M. HENRY. (L.S.)

Witness,

S. E. A. NEWSOME.

LONDON:

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